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May 10, 1956

Subject: Contract RD-94
Proposed Addition of Task 2 for
Study and Research of Audio
Noise Reduction Circuits

Enclosure A: Descriptive Specification "Study and
Research of Audio Noise Reduction
Circuits" PP56-1085, dated May 7, 1956

B: Price Analysis Summary dated May 7, 1956

Dear Sir:

In response to indication of interest by the
Agency, [] Laboratories will be pleased to undertake a
program of study, research and development of audio noise
reduction problems as outlined in the enclosed [] Labo-
ratories' Descriptive Specification.

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We estimate the investigations as proposed
can be accomplished within a period of 12 months based upon
application of one and one-fourth man years effort to the
project by qualified research scientists of our []

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[] is the Director of this laboratory and will have overall
supervision of the project. The research efforts will be
adequately supported by the necessary model shop and drafting
personnel as required.

The results of our efforts in performance of
the work program will be reported in monthly progress reports.
A final report summarizing the total effort on the project
will be submitted within thirty (30) days following the
12-month work program. An experimental model equipment
incorporating the audio noise reduction circuitry developed

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as a result of the work program will also be delivered at the completion of the project.

25X1 An estimated price of \$60,316 (including a fee of \$5,483) is quoted to cover the 12-month program based upon authorization of this work as an additional task under the basic GPPF contract agreement RD-94. A price analysis summary in support of the quoted price is enclosed. The burden rates applied in the price analysis summary are those most recently negotiated with the Military Services as firm [] Laboratories Government research contract work during the period 1 January 1956 through 31 December 1956. These firm rates shall be included in the contract as applicable for the period ending 31 December 1956 and as provisional rates to be applied until firm rates are established for the subsequent periods. The noise reduction program as proposed contemplates the use of several high Q filter networks to accomplish the desired goals. The cost of the component parts of these filter networks is a sizeable item and has been reflected in the "Materials" element of the price analysis summary.

25X1 The terms and provisions of the basic agreement RD-94 will be acceptable under this proposal except that, since the scope of the proposed program includes fields in which NSA has expended large sums of its own funds, we do not consider the Government should be granted a royalty free license on any invention made prior to our entry into a contract for this work even though the invention may be first reduced to practice under this or subsequent contract commitments. Therefore, as permitted under paragraph (b) of the administrative procedures established in the Armed Services Procurement Regulation 9-107.1, revised 23 December 1955, we propose to exclude from the definition of "Subject Invention" in Article 17 of the contract certain [] inventions made in this field prior to start of work on this project. A list of the inventions to be excluded will be forwarded for insertion in the contract amendment prior to its execution.

25X1 The work herein proposed will be performed at [] Laboratories on an unclassified security basis; however, the identity of the requiring activity and their proposed use of the results of the work program will be maintained on a classified basis.

Our proposal is based upon acceptance within forty-five (45) days from date of this letter. If additional

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information is desired in connection with this proposal,
please contact the undersigned.

Very truly yours,


Government Contracting

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DESCRIPTIVE SPECIFICATION
FOR
STUDY AND RESEARCH OF
AUDIO NOISE REDUCTION CIRCUITS
PP56-1085

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May 7, 1956

Introduction

The object of this project is to develop a noise reduction system suitable for use in separating speech intelligence from a signal containing speech and noise. The proposed system would be suitable for use in extracting information in a laboratory or central office from recordings made in the field under noisy conditions. It would probably be too complicated and bulky for field use under many operating conditions. The basic principles of the proposed system have been described by Olson.¹ A reprint of reference 1 is included for descriptive purposes as a part of this specification.

Proposed Investigation

As described in reference 1, the proposed noise reduction system employs a nonlinear element in each of several channels comprising the total transmission band of the system. The nonlinear element allows the useful signal to pass and discriminates against noise, provided the useful signal is greater in amplitude than the noise in the channel. Band-pass filters which pass frequencies over a range of one octave or less are used at the input and output of the nonlinear element in each channel. Since the input and output band-pass filters are confined to one octave or less, there will be no distortion of the transmitted intelligence produced by the system in the form of harmonics, subharmonics, or sum and difference tones.

¹Olson, Harry F., "Electronics," December 1947

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The noise reduction systems described in reference 1 were intended primarily for use in improving the signal-to-noise ratio in music reproducing or transmission systems. They were designed to operate under conditions of relatively high signal-to-noise ratios. For this reason, the number of channels required was relatively small. The proposed system will be designed to process material in which the signal-to-noise ratio may be very low. In certain parts of the frequency spectrum the noise amplitude might be greater than the signal amplitude. Therefore, the number of channels required will be large in order to achieve a greater improvement in the overall signal-to-noise ratio. Provision will be made for immobilizing those channels in which, for a particular application, the noise amplitude may exceed the signal amplitude.

In the development of the audio noise reduction system for speech, it is proposed to limit the frequency range to the region of 1000 to 6000 cycles per second. A study will be made to determine the most suitable number of channels required to give adequate noise reduction in this region. An experimental study will be made of various nonlinear devices suitable for this application. Consideration will be given to the type and sharpness of the band-pass filters required. A laboratory type equipment suitable for experimental test and evaluation will be constructed. Using this equipment, tests will be made to

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determine its effectiveness in improving the signal-to-noise ratio for various types of noise, and for various input signal-to-noise ratios. If these tests indicate the necessity or desirability of modifications in the original equipment, changes will be made to correct the deficiencies. The completed experimental model will be delivered at the conclusion of the contract for the customer's further evaluation and use.

In order to accomplish the work outlined above, it is estimated that a period of approximately one (1) year will be required. This estimate is based on a staff of one engineer working full time, and one engineer working one-fourth time.